Twemlows Hall
Whitchurch

Geophysical Survey

PN: IBV-15-TWE

April 2015

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Project reference	**IBV-15-TWE**
On behalf of	**ib vogt GmbH**
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1 Contents

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2 Summary

This report presents the results of a geophysical survey undertaken on land associated with Twemlows Hall, Whitchurch, Shropshire, on behalf of ib vogt GmbH.

The detailed gradiometer survey covered approximately 23 hectares and identified several former field boundaries that were likely to have been removed and replaced by land drains during the construction of RAF Tilstock.

A strong magnetic disturbance is present over the majority of the survey area. It is probable that the response is from the excavation and reinstatement of the ground during the construction of the airfield, to drain and level the land.

Additional linear and curvilinear anomalies were also detected that were not readily identifiable as archaeology, and may represent further features of the airfield.

Several probable metallic utility pipes (or cables) were also identified around the perimeter of the survey area.

3 Introduction

A geophysical survey was commissioned by ib vogt GmbH on land associated with Twemlows Hall, Whitchurch, Shropshire. (NGR SJ 56450 37300). The purpose of the survey was to determine the presence of any archaeological potential within an area proposed for the development of a photo-voltaic power array.

3.1 Location and land use

The survey area measured approximately 23 hectares and comprised a single field. The land was once part of the former RAF Tilstock airfield that was active during WWII, and is bounded to the east and south by disused concrete runways. Post and wire fencing is present in the north and west of the field, separating it from the adjoining land. The field was used for the cultivation of silage at the time of the survey, apart from a strip along the eastern boundary that was cut and used as a runway for light aircraft. The site location and survey area are shown in drawing IBV-15-TWE.01. The topographical mapping shows the area to be relatively level.

Site history

A cultural heritage impact assessment was undertaken by neo Environmental (2014).

Historical mapping indicates that the land was segmented by several former field boundaries prior to the construction of the airfield, and the western section of the survey area was also wooded (1879-1880 OS map).

The construction of the airfield that was opened in 1942 culminated in the clearance of the 19th Century field boundaries. The survey area has remained largely unchanged since the closure of the airfield in 1946.

A land drainage plan dated 07/10/1971 is held by Mr R. Matson of Twemlows Stud Farm. The map was issued by the then Ministry of Agriculture, Fisheries & Food and was reproduced from War Department plans. It is of note that the 'existing drains' shown on the plan correspond with the field boundaries shown on the 1879-1880 OS map. It can therefore be assumed that the drains were inserted into existing drainage ditches that were associated with the field boundaries or that they were inserted into excavations created by the removal of the field boundaries.

There are no recorded heritage assets within the survey area.

3.2 Geology and soils

The solid geology of the site is believed to be Lias Group mudstone, overlain with Devensian sand and gravel deposits. (British Geological Survey: online: 2015).

3.3 Technique

The survey was undertaken using a magnetic gradiometer that could identify the presence and extent of soil filled anomalies and burnt materials in areas not affected by modern ferrous disturbance. The survey was practiced in accordance with English Heritage (2008) Guideline No 1, *Geophysical survey in archaeological field evaluation*, and the Institute of Field Archaeologists (2002) IFA Paper No 6, *The use of geophysical techniques in archaeological evaluations*.

3.4 Dates and additional information

The survey was undertaken on days between 7th April 2015 and 11th April 2015.

4 Field Methodology

4.1 Geomatic referencing

The data was collected over 30m x 30m survey grids that were initially drafted in CAD software and overlain onto the topographical survey drawing '*Topographical_plan',* provided by the client. The grid was uploaded to a SOKKIA GRX-1 GPS system to enable the accurate setting out of the co-ordinates in the field. Non-magnetic surface flags were used to define the corner points of the grid and incremented trapeze ropes were used for heading and positional markers.

4.2 Instrumentation

A Bartington Grad601-02 magnetic gradiometer was used to collect the magnetic data at 0.25m increments spaced on 1m traverses. The instrument sensitivity was set at 0.1nT. The instrument was balanced in a magnetically stable location and was regularly checked and rebalanced, if necessary throughout the duration of the survey.

4.3 Data processing

The data collected by the instrument was imported into Archaeosurveyor (v.2.5.10.5) software and was de-striped and de-staggered to compensate for heading errors and minor instrument drift (< 2nT).

The final data sets were exported as raster image files for importation into CAD software, where they were scaled and geo-referenced.

4.4 Data presentation

The raw data was clipped between -10nT and 10nT and presented as a 1:3000 greyscale plot in drawing IBV-15-TWE.02.

The processed greyscale data was clipped between -10nT and 10nT and has been presented at 1:1000 scale in drawing IBV-15-TWE.03.

The 1:1000 X-Y trace data is shown in drawing IBV-15-TWE.04 and the 1:1000 interpretation plot in drawing IBV-15-TWE.05.

5 Results

5.1 Areas of magnetic disturbance

The data is dominated by magnetic disturbance, comprised of irregular values that occur over the majority of the survey area. The amplitude of the disturbance is high (< +/- 80nT) and is unlikely to be from general ground disturbance.

The disturbance is associated with a system of presumed land drains that were installed by the Ministry of Defence. It is likely that the response is from the excavation and reinstatement of the field, to drain and level the land, as it was common to use tipped materials such as quarry waste for the construction of airfields.

Several linear dipolar anomalies were identified close to the north, east, south and southwest boundaries of the field. It is probable that they are associated with metallic utility pipes or cables.

Several small pockets of disturbance are also present within the survey area. Anomalies 'A' are located near the western boundary, anomalies 'B' near the southwest corner, and anomalies 'C' in the southeast corner. They are mostly dipolar indicating a single buried feature for each response. It is possible that the anomalies may be footings for poles or structures related to the former airfield.

Numerous isolated dipolar spikes were identified throughout the survey area using the raw X-Y trace plots. They have high magnetic values and are likely to correspond to surface or near-surface ferrous materials such as shotgun cartridges, wire, nails etc. Only the larger spikes have been shown on the interpretation drawing. It is also possible that ordnance may be present within the field which should be verified before the commencement of any intrusive works.

5.2 Positive magnetic anomalies

Positive magnetic anomalies are indicative of an enhanced field gradient, and can be associated with archaeological soil filled features such as cut ditches.

A network of broad, magnetically enhanced linear features has been detected within the survey area.

Several correlate with the former field boundaries on the Twemlows 1879-1880 OS map and the subsequent field drains on the 1971 drainage plan. They have been illustrated in blue on the interpretation drawing and are likely to be land drains that superseded the former field boundaries.

The linear features drawn as yellow are anomalies that match the position of former 1879-1880 field boundaries but are not present on the 1971 drainage plan. It is possible that the magnetic response could be a footprint from the field boundary, but it is also feasible that land drains were also placed along these boundaries and were not included on the 1971 drainage plan.

Finally, the linear features drawn as green are not represented on either the Twemlows 1879-1880 OS map or the 1971 drainage plan. It is possible that they could be former field boundaries that predate the 1879-1880 OS map as they resemble Medieval strip systems,

however it is more likely that they are additional land drains that have not been included on the 1971 drainage plan, as they do not cross the full length of the field and are generally confined to the magnetic disturbance thought to be associated with the construction of the airfield.

Two curvilinear anomalies were detected by the survey. One is in the southeast (D), and the other (E) further north in the field. Both are very weak and associated with scattered isolated magnetic enhancements. It is possible that they could be of archaeological interest; however it is likely that they are associated with the airfield.

A circular anomaly (F) is present in the southwest corner of the survey area. The outline is very weak and is also defined by the presence of the magnetic disturbance associated with the field drainage. It is therefore probable that it coincides with construction of the former airfield.

In the centre of the survey area, several curvilinear anomalies are present (G). They are weak (<2nT) and close to the magnetic disturbance. It is therefore difficult to determine from the shape or context if they are of archaeological interest.

The fragmented linear enhancements in the far northeast of the survey area are also difficult to interpret due to an increased intensity of isolated magnetic responses. It is possible that they could be remnants of a former plough regime; however there is insufficient evidence to support this.

Isolated magnetic enhancements are present in areas outside of the magnetic disturbance. Most are individual responses identified on the raw X-Y trace plots that have low, broad magnetic values. They could be indicative of archaeology when associated with features of known human agency; however it is probable that they represent variations of the underlying geology or deeply buried ferrous metal.

6 Conclusions

A strong magnetic disturbance is present over the majority of the survey area. It is likely that it is associated with the construction of the RAF Tilstock airfield and the insertion of land drains, illustrated on the 1971 Ministry of Agriculture, Fisheries & Food land drainage plan.

Several linear anomalies have been identified from the magnetic survey that correlate with the former field boundaries shown on the Twemlows 1879-1880 OS map. It is likely that the field boundaries were replaced by field drains during the construction of airfield.

Additional linear anomalies not apparent on the OS map and drainage plan were also identified. It is possible that they could be field boundaries that predate the 1879-1880 OS map, but it is likely that they are additional land drains not shown on the 1971 plan, as they only occur within the confines the magnetic disturbance.

Long linear dipolar anomalies occur close to the north, east, south and southwest boundaries of the field. It is probable that they are associated with metallic utility pipes or cables.

Several weak curvilinear anomalies were also identified and annotated as D, E, F and G on the interpretation drawing. Anomalies D, E and F are probably associated with the airfield, whereas anomaly G is very weak, and is difficult to interpret due to an irregular shape and the close context to the magnetic disturbance. As such, it cannot be readily identified as archaeological.

Numerous isolated magnetic enhancements as well as isolated dipolar spikes were identified throughout the survey area using the raw X-Y trace plots. The magnetic enhancements could be indicative of archaeology when associated with known anthropogenic features; however they could also be from variations of the underlying geology or deeply buried ferrous metal. The dipolar spikes have high magnetic values and are likely to correspond to surface or near-surface ferrous materials.

Appendix

7 Detailed Magnetic Survey

7.1 Theory

A detailed magnetic survey involves the detection of small variations in the Earth's magnetic field to locate buried anomalies associated with human activity. Usually, the topsoil will have an increased amount of ferrous minerals than the sub-soil caused by a complex fermentation effect and therefore a higher magnetic susceptibility in non-igneous geologies. The action of digging a ditch or excavating a floor can expose the sub-soil layer that can be filled with debris or topsoil as they are in-filled or silted up. The features will then be magnetically enhanced in comparison to the sub-soil. The strength of anomaly detected by the instrumentation is largely dependent upon the measurable contrast between the buried feature and the surrounding material.

In addition, the action of heating weakly magnetic compounds will convert them to oxides that are demagnetised as they reach their relative Curie temperatures. When cooled they become permanently magnetised and aligned with the geomagnetic field present at the time of heating which is generally greater than the ground that has not been exposed to the high temperatures. This process is referred to as thermoremanence, and can be indicative of human activity, as kilns, ovens, hearths, and destructive burning will all leave a magnetic signature within the subsurface.

7.2 Instrumentation

Fluxgate gradiometer instruments are commonly used in Britain for magnetic surveys. They have two vertically positioned sensors that have a separation of between 0.5m – 1.0m. Both sensors measure the Earth's magnetic field, but the bottom sensor will be affected by local variations in the field created by weakly magnetised buried features. To determine the strength of the buried anomaly, the value of the top sensor is removed from the value of the bottom sensor. This is the magnetic gradient and is measured in nanoteslas (nT). The readings are instant and shown in real-time on a display built into the instrument, and can also be stored in an internal logger. Eden Mapping will use either a Bartington Grad 601-2 fluxgate gradiometer or a Geoscan FM256 fluxgate gradiometer to undertake magnetic surveys.

7.3 Survey Method

An orthogonal grid system is used for the gradiometer survey, and is established using either a 1-person robotic total station or a GPS instrument. For surveys covering large areas, the grid will be drawn in CAD software and overlain onto Ordnance Survey digital data, to be used as a backcloth for the co-ordinates. The co-ordinates can then be transferred to the survey instrument prior to arrival on site. For small areas, a local grid can be established on site to ensure a best fit. If a local grid is used, then survey stakes will be established around the perimeter of the survey area to ensure that the co-ordinates of any detected anomalies can be easily targeted at a later date.

Each grid square will measure either 20m or 30m. The size used is dependent upon the size and shape of the survey area. Trapeze ropes are used by the operator as a reference for both positioning and heading.

A base point with a stable magnetic background will be established either within the survey area or external to it dependent upon ground conditions. The instrument will be balanced from this point and checked regularly for drift. Readings will be taken using the 0.1nT range every 0.25m over 1m traverses.

The data from the instrument will be downloaded during a midday interval and at the end of the shift to monitor quality and the progress of the survey. The data will be post-processed in bespoke software to produce a greyscale interpretation of the data. An X-Y trace map is also produced to aid interpretation. The maps are imported into CAD software as raster images for the production of interpretation and data presentation drawings. A report will also be produced to accompany the drawing.

7.4 Limitations

The success of a magnetic survey detecting archaeological features is dependent upon a measurable contrast between the anomaly and the surrounding ground. The presence of made ground, ferrous materials and burnt materials can all produce strong responses that can mask the presence of buried archaeological features.

Surface features such as buildings, metallic fencing, vehicles, electricity pylons and wind turbines can also have an impact on the magnetic data due to the sensitivity of the instruments. An attempt can be made to remove the magnetic disturbance by post-processing the data in bespoke software, but this cannot reliably be used to detect underlying anomalies and could create false artefacts within the data itself.

Natural sub-surface processes can also produce anomalies that may be mistaken for archaeological features, such as fluvial deposits or the accumulation of sediments in areas prone to flooding. Alternatively, igneous geologies can make it difficult to detect cut features in the sub-surface as there is minimal contrast between the topsoil and sub-soil.

The quality of the data is also reliant upon the operator of the instrument. The data is collected at normal walking pace, therefore it is advantageous to the ground surface to be even and unobstructed. Overgrown land, roughly ploughed fields and heavily saturated ground can all affect the pace of the operator and movement of the instrument sensors that, in turn can produce heading errors and false artefacts in the data. In some instances it may not be possible to undertake the survey until ground conditions are more favourable.

8 References

English Heritage (2008) *Geophysical Survey in Archaeological Field Evaluation*. Research and Professional Services Guideline #1.

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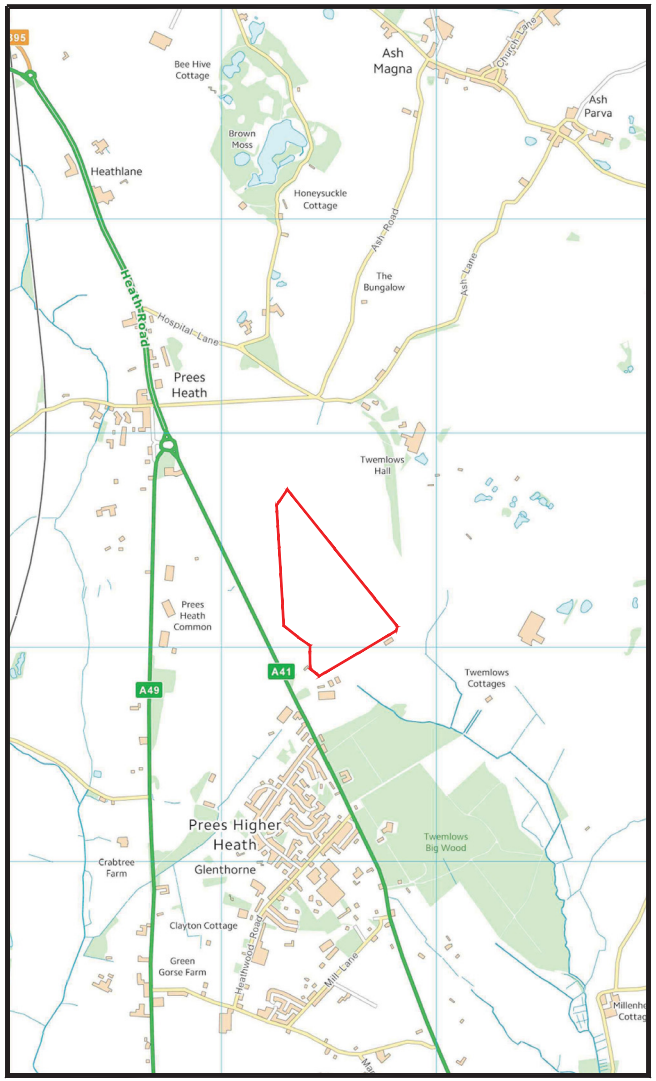
Clark, A (2001) *Seeing Beneath the Soil* (2nd edition). Routledge.

Neo Environmental (2014) *5. Cultural Heritage Assessment: Twemlows Solar Farm.*

Ministry of Agriculture, Fisheries & Food (1971) *Twemlows Hall, Higher Heath Drainage.*



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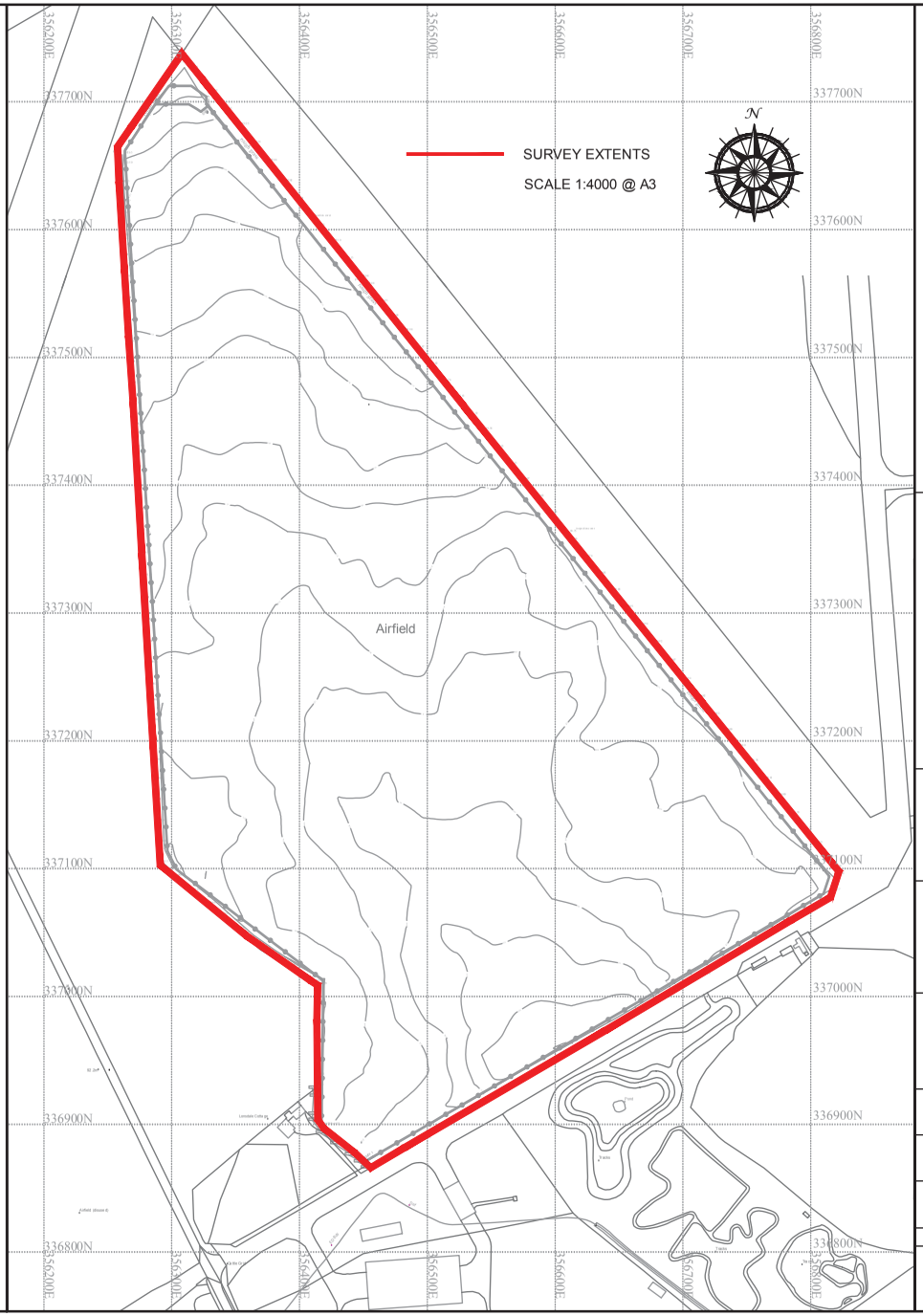

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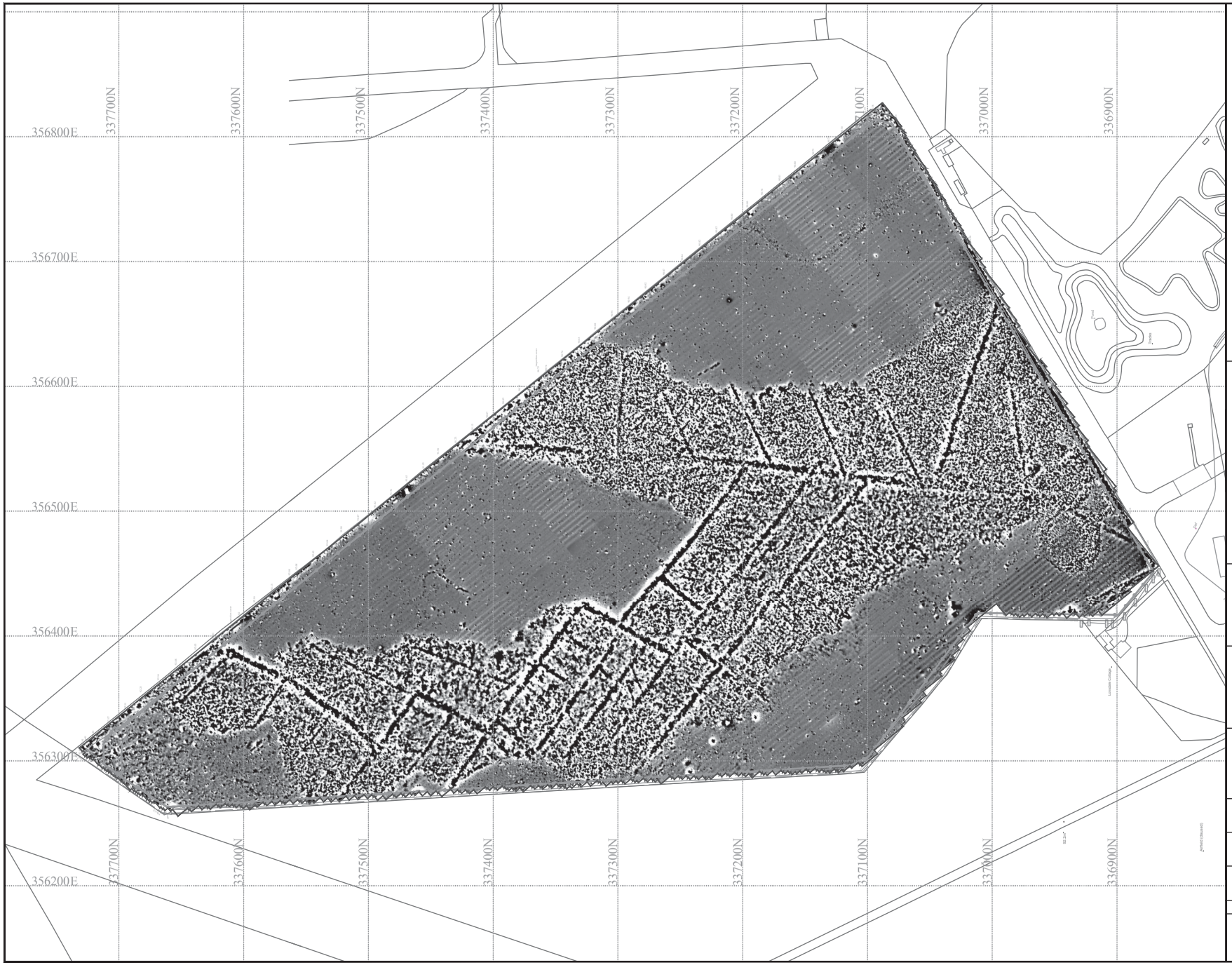
Job Title: Twemlows Hall
Whitchurch, Shropshire

Drawing Title: Site Location & Survey Extents

Scale	As Shown	Drawn	NB
Date	11/04/15	Approved	AP

Revision	Amendments		By	Checked
Project Number	IBV-15-TWE	Drawing No. 01	Revision -	Status Final



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SCALE 1:3000 @ A3

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Client Name

ib vogt GmbH

Job Title

Twemlows Hall
Whitchurch, Shropshire

Drawing Title

Raw Greyscale Gradiometer Data

Scale: 1:3000 @ A3	Drawn: NB
Date: 11/04/15	Approved: AP

Revision	Amendments		By	Checked

Project Number	Drawing No.	Revision	Status
IBV-15-TWE	02	-	Final

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Job Title: Twemlows Hall
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Drawing Title: Processed Greyscale Gradiometer Data

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Date:	1/10/415	Approved:	AP

Job No.	Sub-Job No.	Rev.	Status
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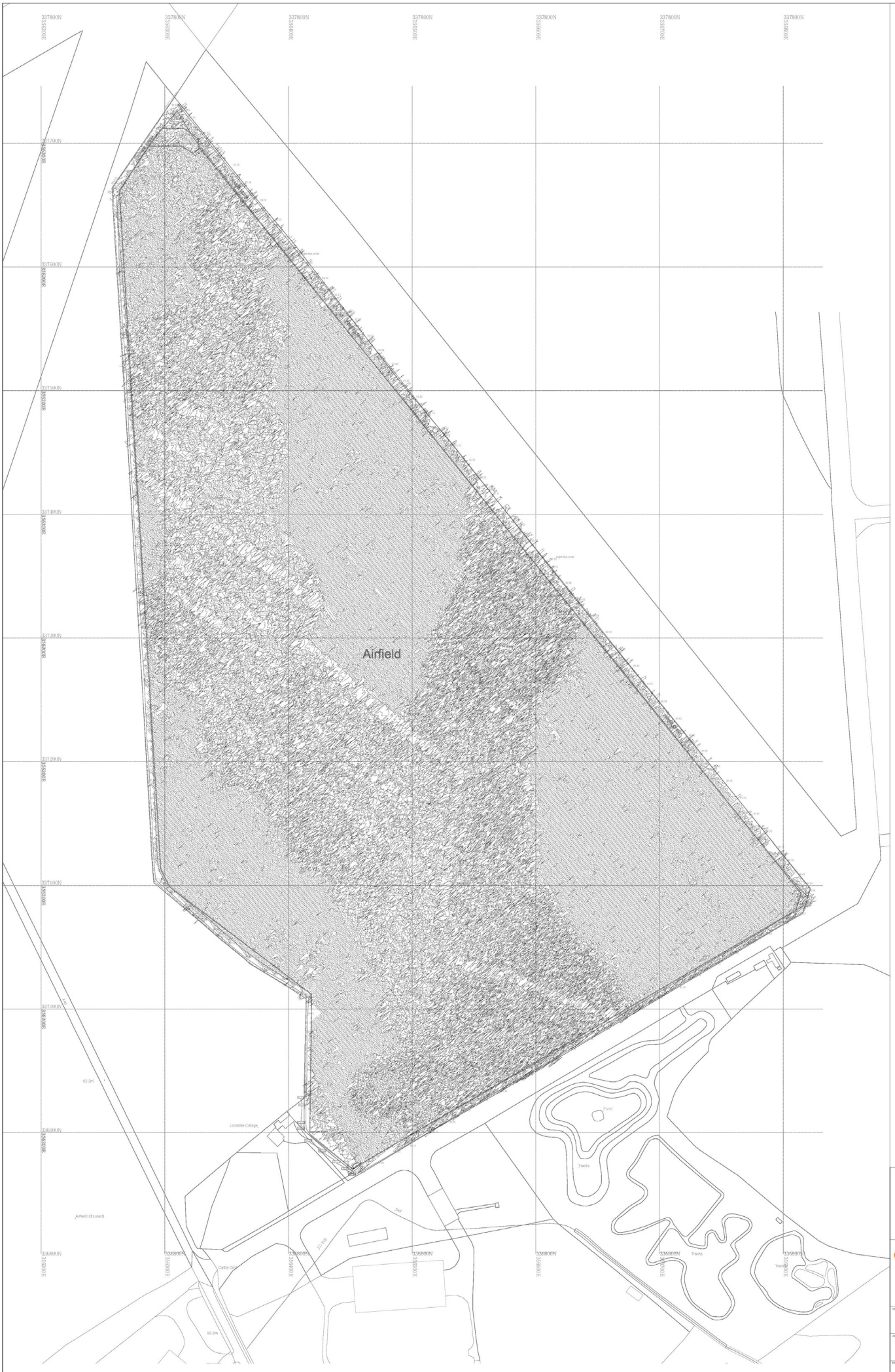

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Drawing Title

Gradiometer X-Y Trace Plot

Scale	1:1000 @ A0	Drawn	NB
Date	11/04/15	Approved	AP

Revision	Amendments	By	Checked
Project Number	Drawing No.	Revision	Status
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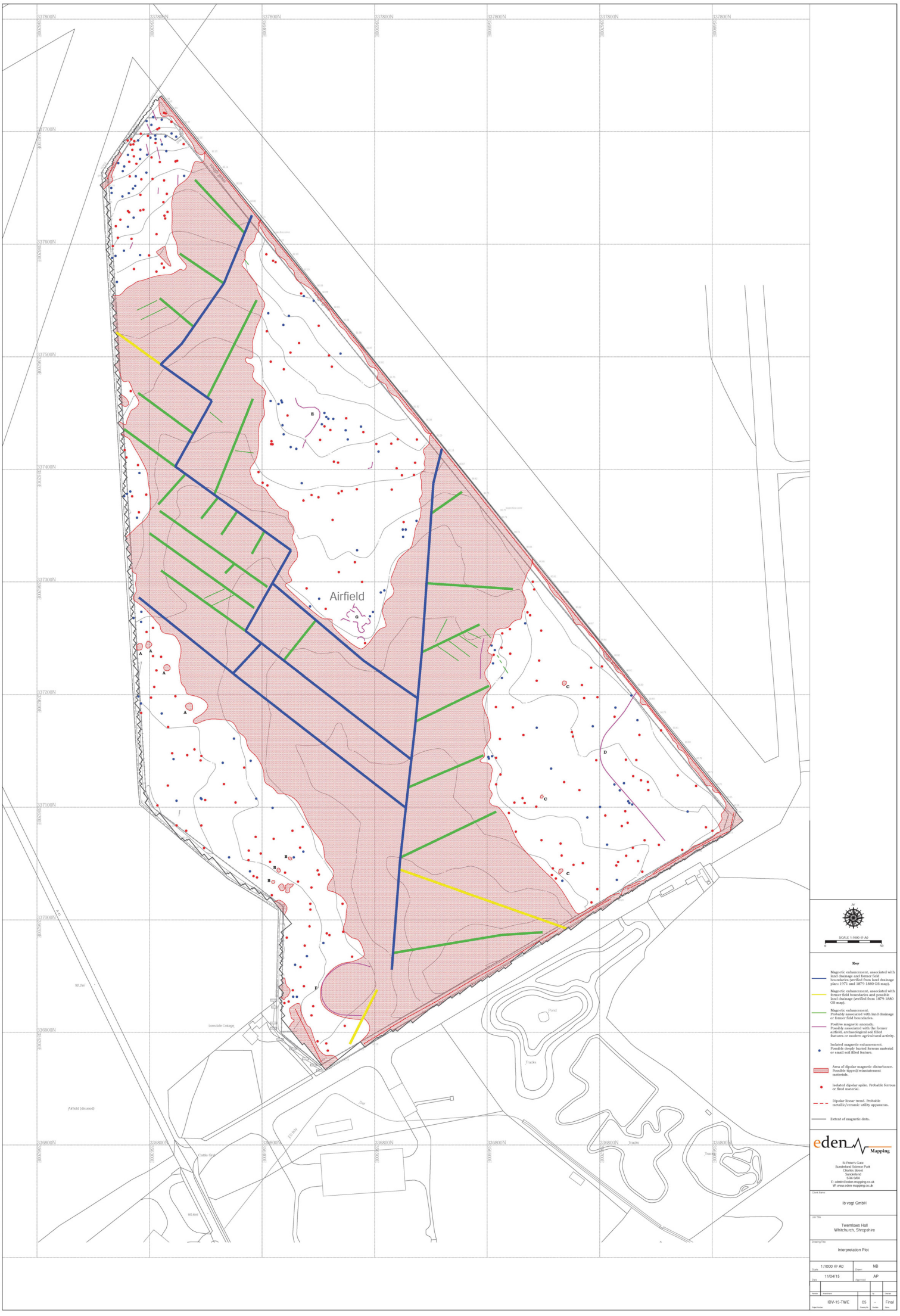
Airfield
A
B
C
D
E
F
G
Tracks
Pond
Lonsdale Cottage
Cattle Grid
Airfield (disused)
Key
Magnetic enhancement, associated with land drainage and former field boundaries [verified from land drainage plan: 1971 and 1879-1880 OS map].
Magnetic enhancement, associated with former field boundaries and possible land drainage [verified from 1879-1880 OS map].
Magnetic enhancement. Probably associated with land drainage or former field boundaries.
Positive magnetic anomaly. Possibly associated with the former airfield, archaeological soil filled features or modern agricultural activity.
Isolated magnetic enhancement. Possible deeply buried ferrous material or small soil filled feature.
Area of dipolar magnetic disturbance. Possible tipped/reinstatement materials.
Isolated dipolar spike. Probable ferrous or fired material.
Dipolar linear trend. Probable metallic/ceramic utility apparatus.
Extent of magnetic data.
SCALE 1:1000 @ A0
0
50
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Job Title
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Drawing Title
Interpretation Plot
Scale
1:1000 @ A0
Drawn
NB
Date
11/04/15
Approved
AP
Project Number
IBV-15-TWE
Drawing No
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Revision
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Status
Final